MYOSITIS OSSIFICANS PROGRESSIVA.

by

WILLIAM FREDERICK MAIR, M.B., Ch.B. Edin.

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A C K N O W L E D G M E N T S.

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CONTENTS.

MYOSITIS OSSIFICANS PROGRESSIVA.

I. INTRODUCTION.

The object of this Thesis is to place on record two cases of this rare disease; and in particular to emphasize the clinical features present in the early stages. It is thus hoped that its early recognition may be facilitated and thereby treatment instituted before the process has gone on to the sad conclusion which is so often the case.

That such treatment up to the present has proved unavailing is, it may be said, a further reason for drawing attention to, and reviewing the literature of this strange disease.

As the Diseases of Infancy and Childhood are pre-eminently the sphere in which preventive medicine has its greatest appeal, it may not be out of place to refer here to the fact that it is difficult, after reviewing the facts already elicited and the knowledge already gained of the pathogenesis of this condition, to believe that it can have other than an ante-natal origin; and to suggest that this also, is a further justification for the subject of this Thesis.

II. DEFINITION.

Myositis Ossificans Progressiva is a peculiar disease of the Locomotory system in the growth period of children; affecting not only the muscles, but tendons, ligaments, fasciae, and aponeuroses; characterised by the appearance in them of masses of bone or of areas of calcification. It is further characterized by the fact that it proceeds by virtue of a series of more or less acute exacerbations of an original attack; in the intervals between which the disease is quiescent, and may indeed regress.

It is very commonly associated with various congenital abnormalities, the commonest being malformation of the great toes.

This Thesis will deal solely with the form of the disease which one has attempted to define above. No further reference will therefore be made to the other forms - such as Myositis Ossificans Traumatica or Circumscripta; nor to those forms the results of repeated traumata.

— TWO TYPICAL CASES OF THE DISEASE. —

III. HISTORICAL.

Since the first case of the disease was mentioned over 200 years ago, not many more than 100 true cases have been recorded.

The earliest record of a case of the disease was that of Guy Patin of Cologne[95] (Aug. 27, 1648) who wrote to one A.F., stating "As for the observation you made of a woman who had become as hard as wood .... it is a very rare case. I cannot remember seeing or reading of anything like it unless it be that which is ordinarily called Lithopaedion sinonense".

The first more accurate description was presented to the Royal Society in London by John Freke[38] in 1743, a youth of 14 years in whom the disease had commenced 3 years previously. The description is good - "joining together (the bony swellings) in all parts of his back as the ramifications of coral do, they make as it were a fixed bony pair of bodice."

The next case maintains the standard of description, and is reported by the Lord Bishop of Cork of that day[26]. At this early date we are able to note several points of great interest to this day - thus we note the early age onset - "in his infancy he was never observed to turn his head round, nor bend his body". The involvement of the masseters - "he could never open his mouth but his teeth being broken by some accident he sucked in spoon meat which was his chiefest food".

"He stood in a kind of sentry-box with a board in a groove placed breast high to lean upon". An interesting side-light on the pathology of the condition is:- "When he was dissected a bone was found in the fleshy part of his arm, quite disengaged from any other bone"; and on the symptoms-"What is odd is that while these bony masses were growing he never complained of any pain in the muscles."

The next series of cases appear to have been recorded principally in England - Abernethy[1] 1830, Caesar Hawkins[48] 1844, and G. Wilkinson[122] 1846. In 1860 Jonathan Hutchinson[57] contributed to the "Archives of Surgery", London, "some examples of "Myositis Ossificans" one at least of which was probably of the progressive variety, as it was stated that the mid-wife noticed a deformity and for this the child was taken to Hospital. This same case was reported on last at 37 years, by which time the disease had run its full course.

In 1864 a Thesis appeared on the subject in Virchow's Archives and in 1868 Muenchmeyer[84] published a very accurate and complete description of the disease, based upon 12 cases - 9 males and 3 females. This author was the first to use the term "progressive", and although he did not actually give his name to the disease; such a land-mark in its history was his paper that it is still known in France as "Le maladie de/

de Muenchmeyer". The next notable step was in 1879 when Helferich[49] drew attention to the occurrence, in a large proportion of cases, of congenital abnormalities of the thumb and great toe. He rightly laid stress on the presence or absence of these in diagnosis. He had 30 cases. By 1884 Pinter had 22; 1896, Pincus, 36. Krause and Trappe (1907) gave an analysis of a series of 60 cases.

Since then cases have occurred, and been reported on, in nearly every country, and by 1900, 78 true cases of the disease had been recorded. (De Witt[30].)

In 1908 Garrod[39] published a paper of extreme importance in diagnosis in which he points out the evanescent nature of the early lesions. I do not think it is an over-statement to say that his lucid account must necessarily have aided early recognition and description of the disease. (St Bart's. Hosp. Reports. 1908. XLIII. p. 43-49).

Another important piece of work must be noted. Goto[43] in 1912 and in 1914 gave a report of a case and a careful review of the pathology. His work was so important that the condition has been named by a Norwegian writer, Johannesen[62] of Christiania - "Hyperplasia Fascialis Progressiva Goto".

A fresh view-point altogether, and fresh complexity, was introduced when Paul Krause in 1907 (Fortschritte a. d. Geb. d. Rontgenstrahlen, vol.XXI, p.229),/

p.229), described a case which he designated Calcinosis Interstitialis Progressiva, believing this a preliminary stage of Myositis Ossificans Progressiva.

In 1909 so great improvement had taken place that the author unhesitatingly states[66] that both the term Myositis Ossificans and the attribute "progressiva" must be abandoned and the diagnosis simply headed "Calcinosis Interstitialis", failing which one might add "et regressiva".

This difficulty cropped up time and again and will be referred to later when an attempt will be made to elucidate to some extent this aspect of the problem.

By the year 1918 only about one hundred authentic cases of Myositis Ossificans Progressiva were known and verified, and this number has not been materially added to since.

More attention, especially on the Continent, has recently been paid to Calcinosis Interstitialis and as recently as July 1925 there appears a review of this aspect of the disease picture. (Archiv. für Klinische Chirurgie. 4. July, 1925). It will be seen therefore, that although diagnosis has been made much oftener in recent years, cases are, fortunately, rare and only about one hundred cases have been recorded in the past 200 and more years.

IV. INCIDENCE.

Cases are, fortunately, extremely rare. Referring first to the British Isles, the writer has met with two, and a careful search with a view to tracing possible other cases has failed to discover any. It is certain that there are none in Edinburgh. The Principal Medical Officer to the Education Authority of Glasgow kindly informs me that he knows of no such cases in the City, though there are over 5,000 children suffering from various physical defects conveyed to their special schools each day. In London 130,000 children are similarly cared for, but amongst all these this disease does not appear to figure. A similar negative result was obtained at the Glasgow Royal Infirmary and at the Western Infirmary, Glasgow, where a search of the records for the past 10 years failed to disclose a single case. The Royal Hospital for Sick Children, Glasgow, had no cases recorded. One case occurred in Edinburgh in 1921 which came later to the Royal Infirmary and is hereafter described as Dr Fleming's case. Two other cases, in sisters, from Tarbrax, have been under observation at the Royal Hospital for Sick Children, Edinburgh, but no further trace of these two patients can be found in that district. Continuing this inquiry at the Royal Victoria/

Victoria Infirmary, Newcastle-on-Tyne, Prof. Sir Thomas Oliver, M.D., F.R.C.P.(Lond.), was so good as to refer the writer to Prof. George R. Murray, M.D., F.R.C.P.(Lond.), as he recollected the latter physician having a case under his charge. Prof. Murray very kindly wrote to say that this case was sent to him by the late Dr George A. Gibson of Edinburgh, in 1903, and that on condition that nothing was published regarding it. This man appears to have been a famous case and to have gone the rounds of the hospitals throughout the country. Dr R.W. Johnstone who was then Resident Physician to Dr Gibson at the Royal Infirmary, Edinburgh, writes: "I remember he was like a log from head to foot ..... he had to be propped in one corner of a cab to the other in order to be conveyed to the Royal Medical Society buildings where the case was demonstrated." This undoubted case appears to have been published in 1901[16] and this appears to be the only authentic case passing through the Edinburgh schools in the last 20 years.

This case is one of considerable importance, however, as the patient's father had died from the same disease at 33. The further history of the patient was unobtainable. Dr Vaughan, who with Burton-Fanning[16] described this case and first noted this hereditary factor, kindly writes on 25th Aug. 1925, to say that he knows nothing of this patient's ultimate history. (Photograph on page 14).

The/

The disease seems to have a predilection for the Anglo-Saxon Race.

Cases are by no means common in France. At a recent demonstration of a case in Paris by Drs. Veau and Lamy[115] in March 1925 one of the members said "I have never seen such a case - this unfortunate child, if he lives, will become a man of stone." At the same meeting M. le Mee recalled a case seen by M. Rieffel and himself in 1906,[68] not having apparently encountered more since that time. This is the same case as is referred to in La Presse Medicale, 28 Feb. 1925.

Cases have occurred in practically every country, the following table gives some idea of the relative frequency:-

England	22
Germany	22
America	4
France	5
Russia	2

Sex Incidence.

The disease is unquestionably commoner in boys, the ratio having been variously stated as high as 4 - 1; my own series of cases working out at almost exactly $2\frac{1}{2}$ - 1.

This preponderance of males has been characteristic of the disease since the earliest observations. Various figures have been put forward from time

to/

to time. Opie[90] gave the ratio as 3 - 2; and a French analysis - Gazette des Hôpitaux - p.1671, 1905, "of 24 cases, 5 were girls".

Age of Onset.

Though the age of onset is universally admitted to be usually in infancy or early childhood, comparatively few observers seem to have emphasized the point that the disease may, apart from the congenital abnormalities associated with it, be present at birth. This was the condition in one of my cases (T.S.). It has been observed before, particularly by Pincus[97] who was so impressed by its occurrence that he based his theory of causation on this finding and attributed the condition to "traumatisme du passage de l'enfant à travers la filière pelvienne".
The third case is that reported by Rosenstirn of San Francisco[102] who stated "immediately after birth the midwife noticed a swelling". Apart from this reference one of the earliest dates of onset was in a case recorded by Kümmell in which the disease was first observed 14 days after birth. In my second case the disease was first noticed 2 weeks after birth. One more example of early onset is afforded in Jonathan Hutchinson's paper[57] in which the midwife noticed the deformity, but I would wish to draw attention to the fact that apart from the congenital deformity/

deformity the child may be born actually with the lesions of Myositis Ossificans already in a state of activity.

Apart from these cases, the age of onset varies considerably; it is always, if the true disease picture is referred to, in the period of growth. Various figures have been given to illustrate this point: my own are as follows:-

Age of Onset.

	Birth	3	
	2 weeks	2	
Up to	1 year	6	
" "	2 years	10	38
" "	5 years	6	
" "	puberty	11	+ 1 = 39.

After puberty 1 at age 15 following injury, but congenital deformities of the toes were present.

These figures would seem to point to the first two years of life as the commonest period of commencement, as it will be seen that 21 of the 39 cases occurred during this period.

V. AETIOLOGY.

The question of the aetiology of this strange disease has exercised the minds of all observers. During this period many theories have been propounded and relinquished.

We have to consider:-

Heredity.

Is there evidence of Myositis Ossificans Progressiva being an hereditary disease?

The following references, especially in view of the limited number of cases of the disease as a whole, have led me to the conclusion that there is strong evidence in support of this view:-

The case reported by Burton-Fanning and Vaughan[16] in the Lancet, 1901, II, p. 849.

"There is very distinct evidence of the disease in the patient's father, who suffered from Myositis Ossificans and congenital deformity of the thumbs, having no joint beyond the metacarpal. The son presented the typical picture of Myositis Ossificans Progressiva with deformity of the great toe."

This patient in adult life found his way to Glasgow and was also a patient in the Royal Infirmary, Edinburgh, as before mentioned, under the care of the late Dr George A. Gibson. He was photographed and an X-Ray made while in Glasgow (both reproduced on p. 14) and these are of interest as illustrating one of the few cases to have reached maturity and secondly as showing the comparatively rare affection of the lower limbs.

Sympson,[109] Lancet 1892, p.1485, records a case in which the father suffered from microdactylia and hallux valgus with absence of one phalanx of the great toes, but no osseous lesions. The son had the same deformity and the typical picture of Myositis Ossificans Progressiva.

Gaster[40] in a discussion reported in the West London Med. Journal 1905, vol. 10, p.37, states:- "I have a family in which the father and grandfather had Myositis Ossificans and the three sons suffer from the same illness. Mother and daughters (2) are free from it. Two sons had two daughters (babies) without it."

This/

This case would suggest a transmission through the females to the males, as in Haemophilia and more particularly the muscular dystrophies.

The Relation to Rheumatic Infection.

This is a problem the importance of which it is difficult to assess at its proper value. It has suggested itself to many observers, notably to Stephen Paget[92] who noted that in the family history of one of his cases Rheumatism (and also Malignant disease) figures strongly.

Other examples are not wanting, on a careful study of the literature. E.g. Painter and Clarke[93] - (Amer. Jour. of Orthopaedic Surgery, 1908-9, p.626) mention a case in which the family for generations back had suffered from Rheumatic Torticollis. I would desire to mention this case particularly in view of the fact, which is evident in so many early cases, that the disease often has one of its earliest sites in one or other Sterno-mastoid.

Riely in the same journal, replying to Albee, mentions a case following Rheumatic Infection with Rheumatic Endocarditis. Another reference is in the Quart. Med. Journal, 1901, Vol. 9, p.25, where the father of a case suffered from Rheumatism and the sister from Rheumatic Fever. Lendon[69] (1887) reports a/

a case whose brother and sister had Rheumatic Fever.

A very definite statement is made by Lohr[73]; onset of disease 4½ years before; previous Rheumatism in neck, back and left arm, which became paralysed and later the seat of calcification.

The mother of one of my cases (T.S.) suffered severely from Rheumatism.

While admitting that a history of Rheumatism may be said to be indefinite in very many cases, the foregoing appear to be well-authenticated, and therefore I would suggest that at least the possibility of the disease being in some way connected with Rheumatic Infection should not be lightly dismissed.

The Relationship to Disease of the Central Nervous System.

A curious coexistence of this disease and Epilepsy is observed in the recorded cases. Frattin[37] had a case who suffered from Epilepsy at an early age.

In Lendon's case, already referred to under Rheumatism, the child suffered from convulsions.

In the Indian Medical Gazette (Vol. 47, 1912, p.148) is recorded a typical case associated with imbecility; and a case reported by Comby and Davel[25] appears to have been of similar character.

While admitting the relative frequency of Epilepsy/

Epilepsy in youth, when one adds that there has also been observed Imbecility, the question arises whether there is not an associated nervous system lesion in certain cases.

The existence of a Trophoneurosis as at least a contributory factor in the causation of Myositis Ossificans Progressiva has occupied the attention of several observers, notably Nicoladoni[86] who based his theory of the causation on this factor; and Israel[58] who described a case under the term - Myositis Ossificans Neurotica.

His paper may be briefly summarized: A patient was wounded in the spinal column by shrapnel at the level of the 9th Thoracic vertebra. Complete paralysis of both legs and loss of sensation followed. Two months later swelling of the leg, which started 14 days after the wound, was still present; one month later a definite bony swelling was present in the groin. The condition progressed from this point almost as in Myositis Ossificans Progressiva.
He suggests as a result of the study of this case that these conditions represent "a special tissue reaction in limbs with paralysis of central origin."

But without carrying the argument so far, it may be pointed out that in all cases of Myositis Ossificans Progressiva there is a greater or less degree of atrophy of the unaffected muscles also. The occasional presence/

presence may be recalled of bony deposits in the muscles in Locomotor Ataxia.

The Rôle of Trauma.

Without going so far as to agree with Pincus and blame the whole process on a birth-trauma, trauma is an undoubted factor in the production of the lesions of the disease. It would appear, however, that it does little more than determine the site at which a lesion will develop in an individual who, for the sake of convenience, we will describe as having already the potentialities of abnormal bone-formation. Abernethy[1] was the first (1830) to note that in his case the least contusion started a lesion; an observation which is equally true of my own two cases. I would wish to emphasize, however, that trauma may be the starting point, in what we will call a susceptible individual; not only of one lesion at the site of the trauma, but of the whole dread sequence of events which we are to follow later. Here lies its importance. Cases which illustrate this are not lacking, commencing with Lendon's classical case[69] (1887) where a blow across the shoulders (at 8 years) was followed by a large lump. Thereafter the disease progressed remorselessly until the patient was as helpless as any advanced case of this disease.

The "susceptible" individual referred to, it may be/

be stated, is sometimes born with either the typical congenital deformity or others superadded. As in a case reported by Thomas & Harrison[112] (Ann. Surg. 1917, LXVI, 614-615), in which a girl aet. 4 years having been born with malformation of the great toe, fell, after which a lump developed in the back, and others appeared, followed by limitation of movement of the spine.

A similar sequence of events is seen in Morian's paper[82] where again the child was born with micro-dactylia but showed no lesions at birth.

Takasaki (Case II) p.64 refers to a girl who fell, bruising the back: after a week a swelling appeared with subsequent induration and limitation of movement.

Does Infection play a part?

The relation to Rheumatic Infection has already been discussed.
The association of the disease with a form of septic-aemia has attracted some adherents; but in all cases in which I have been able to find the results of blood culture examinations, these have proved negative. The disease has been recorded as following so many infectious diseases that it is impossible to assign to any of them the definite causal factor. Thus I have records of the disease following:- smallpox, measles, mumps, the association of whooping-cough and measles in four cases is definite (53), (112),

(108)/

(108) and my own (T.S.). Chickenpox, diphtheria and scarlet fever have all been noted as precursors, and in one case Typhoid fever during the mother's pregnancy. (Garrod). It has also followed after puerperal septicaemia. It must in justice be noted that in several cases the lymph glands in the neighbourhood of the affected area have swelled up and been the seat of inflammation of ordinary type. Two cases at least appear to have followed the removal of cervical glands[3] and [25].

VI. CLINICAL FEATURES.

The disease is characterized by the appearance, at a varying interval of time, of swellings of which the consistence varies from that of a soft, fluctuating, cyst-like structure to a densely hard substance from the commencement. These swellings may be present at birth; or more commonly appear shortly after; they may arise spontaneously or they may follow on trauma, however slight.

They are for the most part asymmetrical, although symmetry has been observed.

While in the active or sub-acute stages, they are capable of great variations in shape and size; and/

and an elongated swelling, may, by the prominence of one part of its length on one day and of another the next, give a fictitious appearance of a mass moving about from place to place. This is, indeed, very naturally, the way in which parents are wont to describe the changes in the size and position of the swellings - that "they have moved about".

The swellings arise in two distinct ways:
(1) the swelling may be of hard consistence from the first time it is observed; and may so remain; or
(2) more commonly the swelling appears as a semi-soft, it may be almost fluctuating body, over which the skin is often bluish-red and may be tender.

It is possible at this stage for this swelling to disappear, leaving no trace of its presence, and I have observed this in one of my cases; but more commonly, unfortunately, after a few days, the swelling becomes smaller, harder, and in a few days more the bony lumps into which it is going to subdivide are felt under the skin. Thereafter the apparently active nature of the process ceases and the bony masses are left behind.

By this time probably there is another swelling forming, so that the mother's description may well be correct when she says:-"Scarcely a day passed without a swelling appearing over some part of the child's back."

In some cases the appearance of a number of these swellings appears to coincide, and then a period of remission occurs; as if the malady were progressing by a series of thrusts, but I would suggest that it is equally common especially up till the age of 4-5, say, to find a gradually progressing sub-acute manifestation of the disease and then to find remission; with, it may be, an occasional acute or sub-acute fairly local manifestation. This has been the case in the two cases under review.

The swellings which are left are bony-hard to the touch, the overlying skin can in most instances be freely moved over them (the exception to this statement will be mentioned later).

While still referring to Myositis Ossificans Progressiva I wish to state here that it is possible for the bony material lying underneath the skin to so press upon and injure its vitality as to ulcerate through. Following upon this accident there is a discharge of white, chalky, amorphous debris and healing takes place fairly rapidly thereafter. (This point will be referred to later).

Finally it is possible and indeed of fairly frequent occurrence to find that the disease can regress. This is a point which so far seems to have attracted attention very rarely. But evidence is not lacking, as witness the case referred to by Stephen/

Stephen Paget[92] who mentions that a patient of his father's, writing to him 10 years later states: "The whole front is much better: the chest and sides move very well". This in 1893 and in 1895 Paget himself comments upon the capability that the osseous lesions have of disappearing. A case is reported on[66] where both the foregoing events took place. Some lesions discharged semi-fluid contents and others disappeared completely, leaving no trace.

Krause[66] quotes another case and in my own case (T.S.) considerable improvement has occurred, not only in the direction of lessening the limitation of movement, but also in the disappearance of some of the bony lesions.

It is obvious that if a muscle is ossified practically from its origin to its insertion its function is abolished and in the case for example of the Pectorals, a greater or less degree of limitation of movement of the limb takes place, amounting eventually to complete fixation.

Hence are brought about the disabilities and crippling deformities of this disease.

The Distribution of the Lesions.

It would appear that any of the striped musculature of the body, with some exceptions, can be the seat of the lesions of Myositis Ossificans.

These/

These muscles, which have never been known to be attacked, are the heart and the diaphragm, the larynx, the tongue, and the sphincters. For the rest, the disease very commonly starts in the region of the cervical spine and shoulders. It may also commence upon the scalp as in one of my cases, and in Case 96. A striking feature and one not hitherto referred to is the almost invariable involvement and indeed the frequent commencement of the disease in one or other Sterno-mastoid muscle. This was the starting-point in one of my cases (B.R.) and was present bilaterally in the other. The same starting-point is noted in the French[25], and in the American literature (71), (53), and (108) . The disease sometimes has its origin in or about the temporo-mandibular articulation, or before or behind the ear; these two modes of origin, and the appearance of a single lump on the back of the child, appear to be the common modes of onset.

In other cases it has commenced in the lumbar region and in yet others has had every appearance of a true Rheumatic Infection with pyrexia and swelling of the joints which were later to be the site of ossifying change in their neighbourhood.

From the commoner starting-points it spreads downwards as a rule, sometimes closely following the spine, but I would suggest that in the average case and unless the disease has lasted a particularly long time,/

time, it is rare to find the lower limbs affected.

The intercostals are happily affected late if at all, and the same observation, one is glad to say, is true of the masseters, which are, however, curiously often affected where the disease-process has been at work over a long period.

The lesions on the whole tend to attack the dorsal aspect of the trunk rather than the ventral, though cases are on record where the opposite was the case. (Anat. Soc. Gt. Brit. L. 1916).

The abdominal muscles are not very often affected, and when this is the case the lesion appears as a thin but very hard bony ridge, which has been described in some cases, as well as in one of my own, as arising from the ribs above and being attached to the bones of the pelvis below. The eye muscles have been the seat of the change and in one case the lesion was present in the choroid.

The presence of Other Congenital Abnormalities.

Since Helferich first stated[49] in 1887 that 75% of cases of true Myositis Ossificans Progressiva possessed one or more congenital deformities, much attention has been paid to this point and its presence or absence noted in nearly every case.

(Before this, Gerber in 1875 had observed the association/

association of Hallux Valgus with this disease).

Dealing first with congenital deformities of the toes and hands, these are by no means always both present in any given case; for example, of 27 cases:-

Great toes alone	13
Great toes and thumbs	11
Great toes and one thumb or other finger	2
Fingers alone	1

The deformity is truly congenital and instances are not wanting, as already stated, where the father of the affected person has suffered from the same error of development.

Though usually described as microdactylia the mode of production is not constant: the great toe may be diminished in size and smaller than the second toe even though it may still possess two phalanges. More frequently however there is present an ankylosis of the interphalangeal joint or of the metatarso-phalangeal joint and absence of one phalanx.

The same lesion, or lesions, is the cause of the dwarfing of the thumb which occurs in certain cases or else a dwarfing of the metacarpal itself.

There has also been recorded in several cases an exostosis on the head of the phalanx of the Right middle finger. (Clin. Soc. Trans. Vol. XXXII, p. 1) and, by the French, absence of the flexors of the thumb, and deformities of the fifth finger of both hands.

In addition to this microdactylia we are frequently/

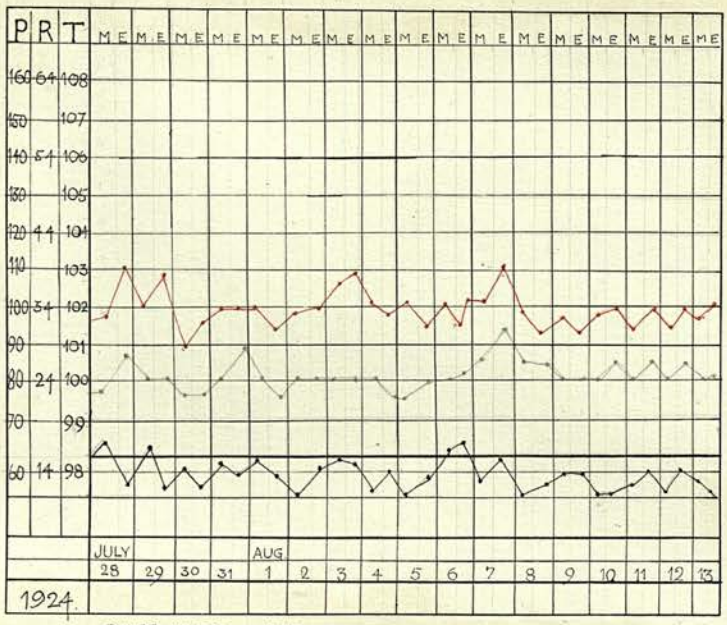
frequently met with double congenital Hallux Valgus, usually associated with other congenital defect such as absence of one phalanx.

Nor are these the only congenital defects from which these children may suffer: cases are on record where there has existed also absence of the lobes of both ears, absence of the two upper incisors, and also Spina Bifida; though all of these are, of course, of much rarer occurrence than microdactylia.

Temperature.

It is generally stated that, during the acute or subacute "phase" of the disease; the temperature shows an evening rise; but I am unable to confirm this finding as in neither of my cases was there ever observed any rise of temperature apart from that occasioned by the frequent attacks of respiratory catarrh to which both were peculiarly liable. The rise of temperature is stated in the French literature to be 38° in the morning, 38.5° in the evening, and this is confirmed by the American observers, McKinnon[77], Painter & Clarke[93], and in Garrod's work[39] who all refer to "frequent rises of evening temperature".

CHART on page 29.



PULSE IN RED. RESPIRATION IN GREEN. TEMPERATURE IN BLACK.

Symptoms.

The general symptoms one would expect in a disease of this character to be much more severe, are conspicuous by their fewness.

It is remarkable how painless the whole process appears to be and the children appear, it is good to state, perfectly happy and contented. One has seen these lumps come and go without the child indicating in any way their presence; except perhaps in the case of lumps forming on the back, where they seem to cause a certain discomfort which the child attempts to palliate by rolling gently from side to side. Even when the masses are large, and, one would think, bound to involve nerve trunks, this does not appear to happen. The children are often painfully thin, and/

and this is no doubt partly due to the atrophy of unaffected muscles which accompanies the disease-process.

The general health appears to be but little affected in the early stages, whilst the chest is still fairly mobile.

Complications.

The complications of the disease arise under various heads; they may be due to the actual presence of the bony masses, or to Infection, the invasion of which is assisted by the immobilisation of the parts.

The presence of the early manifestations of the disease is common in the cervical region, as has already been observed; and the swelling and induration, especially if bilateral, have sometimes given rise to dysphagia and interference with respiration.

The progressive involvement of the muscles of respiration brings about a greater or less degree of dyspnoea. The embarrassment of respiration makes the subject more liable to repeated attacks of Bronchitis, and often to a terminal attack of acute Pneumonia. In addition, the lungs are frequently the seat of Tuberculous manifestations.

VII. CLINICAL HISTORY AND DESCRIPTION OF TWO CASES.

CASE I.

THOMAS SPRINGALL,

Age. 4 years.

Address:- 227 Admiralty Road, Rosyth, Dunfermline.

Date of examination:- July 16th, 1924.

Birth place:- Rosyth.

Family History.

Patient's mother is alive and well: since this child she has had another full-time child which was a Persistent R.O.P. and was still-born. There was apparently no sign of any deformity or abnormality of this child. Father alive and well: no congenital deformities. Grandparents on both sides of the family alive and have apparently never suffered from any serious illness.

While six months pregnant with the present child (patient) the patient's mother suffered from an illness which was described as "Rheumatism and Catarrh of the womb".

One brother alive, age 8½, perfectly healthy boy.

One brother died, age 4½, of Measles, followed by Whooping-cough and Pneumonia.

Previous Illness.

At 4 months old patient had Broncho-pneumonia, Measles at 2 years, and Influenza following this.

Present Illness.

The confinement was a difficult one, and instruments were applied. Immediately after the birth of the child four swellings were observed on the head. These were two on each side of the temple, each about the size of a marble. In consistence they were hard and at first at least could not be moved about.

The child appeared to be perfectly normal otherwise, except for the presence of bilateral deformity of the great toes which consisted of a double congenital Hallux Valgus; and for the fact that he was subject to attacks of screaming at night, which, the mother thinks, however, were not due to pain occasioned by the presence of the swellings. That these swellings must undoubtedly have been present at birth is proved by the fact that the mother was told that they were the result of the application of forceps at the confinement.

These four lumps grew at one time larger and then smaller, and became more mobile.

At 8 months the child was taken to the Royal Hospital/

Hospital for Sick Children, Edinburgh, with the complaint that "the big toes had been turned in since birth". An X-Ray photograph taken at this time shows the condition of bilateral Hallux Valgus. There appears to have been little or no change in the condition until at 14 months the child was again taken to Hospital where three of the lumps were removed. The hospital records state that the "exostosis of the skull" had recurred and was again removed, the child being now aged 1 year and 8 months. Unfortunately no recordsof the microscopical examination of the tissue removed are available. About this time another swelling was making its appearance in the occipital region: this swelling was hard and fixed, and appeared to cause him some discomfort as he was accustomed to rub it. Although this swelling was capable of variation in size it never disappeared completely.

At three years of age there appeared a number of masses behind the Right ear, which resembled enlarged glands from an infection of the throat. These were poulticed with Antiphlogistine. This large swelling appeared also to get smaller, but as it did so it seemed to the mother as if it were reappearing on the other side of the neck; actually, this was, of course a fresh involvement. Almost immediately following this the whole of the Right shoulder began to swell. This swelling took the form of a semi-soft, red swelling which/

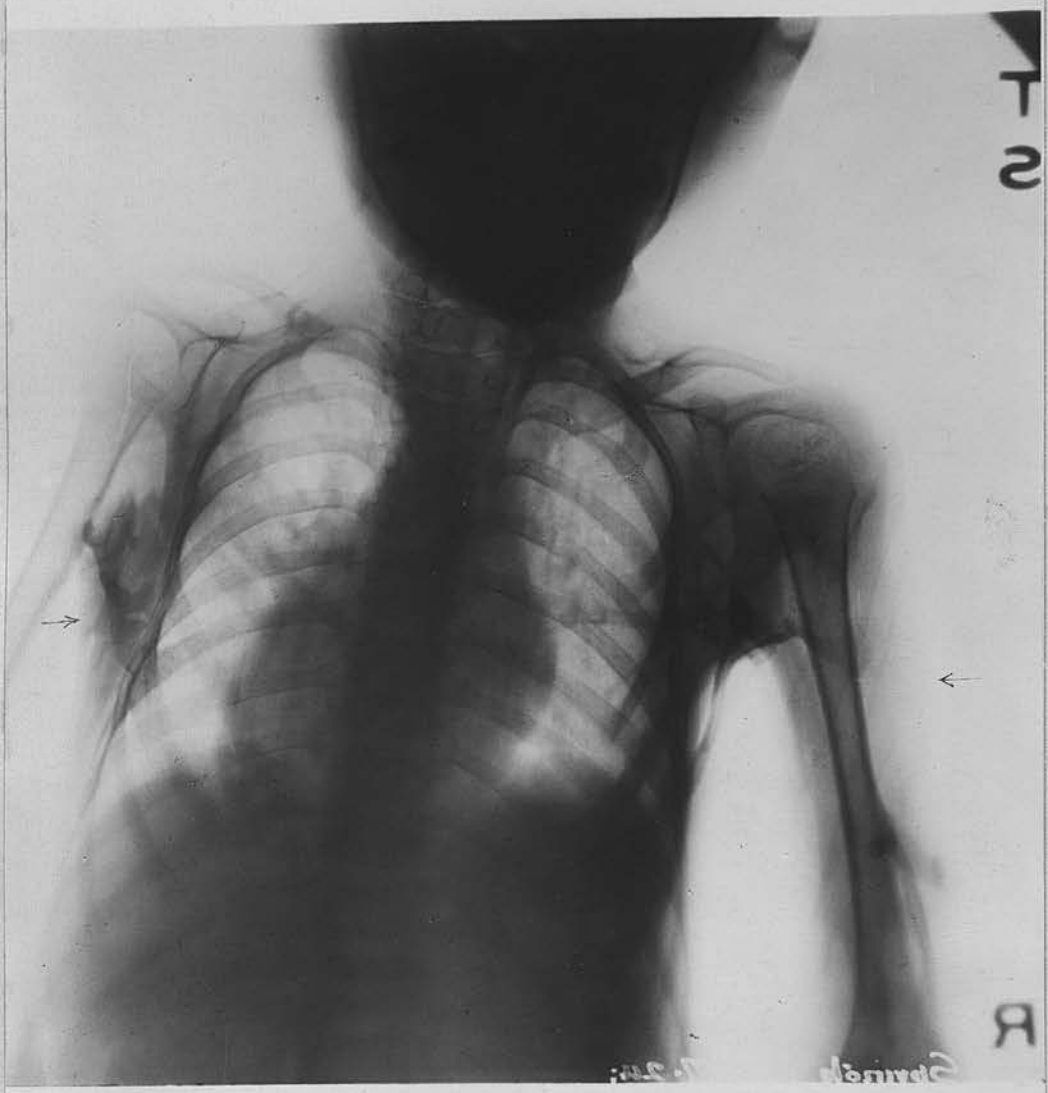
which was tender to the touch. It was also noticed that the whole shoulder girdle appeared to stiffen.

This swelling did not disappear completely but seemed to break up into hard lumps which one week later commenced to appear all down the right side of the upper vertebral spine. There were left at this time some very hard nodules over the right scapula. The last swelling to appear of this group on the right side was a large one over the iliac bone. As soon as the right side seemed more or less quiescent, the disease/

disease process commenced de novo in the left side. The disease again became manifest in the shoulder and passed downwards, as it were, terminating in a swelling in the left lumbar region. This last differed from the majority of its predecessors inasmuch as it appeared from the first as a large bony mass.

From this time onwards scarcely a day passed without either a swelling appearing over some part of the child's back, or without some change in the shape or consistence of the existing ones. There were apparently two different modes of formation:- either they arose as a hard swelling from the first and persisted, or more commonly, as a cyst-like, fluctuating structure, of a bluish-red colour, which varied in size a good deal, and finally resolved itself into one or more densely hard masses. In other instances the swellings grew smaller, and in a few disappeared completely. In August 1923, that is at 3 years of age, the pectoral muscles first became affected; the process in this instance being apparently a fairly gradual and insidious one, increasing difficulty in movement being experienced; the arms meantime being more and more closely approximated to the sides. Eventually it was found impossible to get a finger between the arms and the sides of the thorax. The

sides/



Radiogram to show more particularly the ossification in the Pectoral muscles.

sides of the chest wall were marked where the arms were pressed against it. At this period the arms were being gently massaged and moved passively. Coincident with the restriction of movement of the arms, the retraction of the sterno-mastoid in particular/

particular caused the head to be very much drawn down, and the chin to be approximated to the sternum: this feature became so marked that it became impossible to get ordinary garments off or on. At Christmas 1923, swellings appeared in both upper arms, at first only palpable when the child's arms were being rubbed. The whole of the elbow-joint region appeared to swell and lose its shape. The swelling in the elbow-joint disappeared, leaving the disease particularly manifest in the Biceps tendon, where it has persisted until quite recently. Since this date the only fresh swellings to appear have been several over the Frontal region; and these invariably the result of Trauma. These generally occur over the Right Frontal Bone and appear as a semi-soft purplish swelling which never becomes densely hard but always seems to leave a certain degree of induration for some time and then clears up completely.

To illustrate the presence of recent swellings on the forehead.

To show the bands of bone in the muscles of the back (observe behind the cardiac shadow) and, below, the marked and almost complete ossification of the Erectores Spinae.

From Christmas 1923 until the present date his condition has been little changed except for the fact that 2 months ago a band of densely hard material came up in the abdominal wall and has remained practically unchanged since. Also the band in the left arm appears to have become stiffer and to have involved more of the biceps muscle.

In general health, in spirits, and in mental development the child appears to be well up to normal standard.

The patient was seen again on Jan. 26th 1925 when the following condition was found:-

The general progress of the disease appeared to be arrested; or the disease process in the quiescent stage.

The only fresh development was the occurrence of a fairly recent and densely hard swelling on the left side of the natal cleft, internal to the Posterior Superior Spine.

The movements of the arms were definitely greater than when last seen and there was a greater space between the arms and the chest-wall. There was slight antero-posterior movements of the arms. One of the masses which one had observed and photographed was seen to have disappeared from the right side of the back.

The general health continued to be excellent, apart from a slight tendency to take colds easily; and the child was bright, alert, and responsive.

Urine.

The urine at no time showed any abnormality either in its quantity or its constituents.

Blood examination.

It was not deemed advisable to undertake an examination of the blood, as the mere trauma of a needle puncture has sufficed in some cases to determine the site of bone formation.

Condition on Examination. (16.7.24)

The child is a bright and intelligent boy, the expression of the face is pleasant, and he plays, so far as the limitation of movement of his arms will permit, like any other child. The child is alert and takes an interest in all that is going on around him. He lies or sits up in bed without assistance; he can walk about fairly well, but he gets readily tired. His attitude when sitting up in bed is with the head bent slightly forwards on the trunk and turned a little towards the Right. He cannot move his arms and they are fixed in a position of slight flexion at the elbows, the hands being held midway between pronation and supination. The fingers, hands, and all the joints of fingers and hands are free from deformity of any kind.

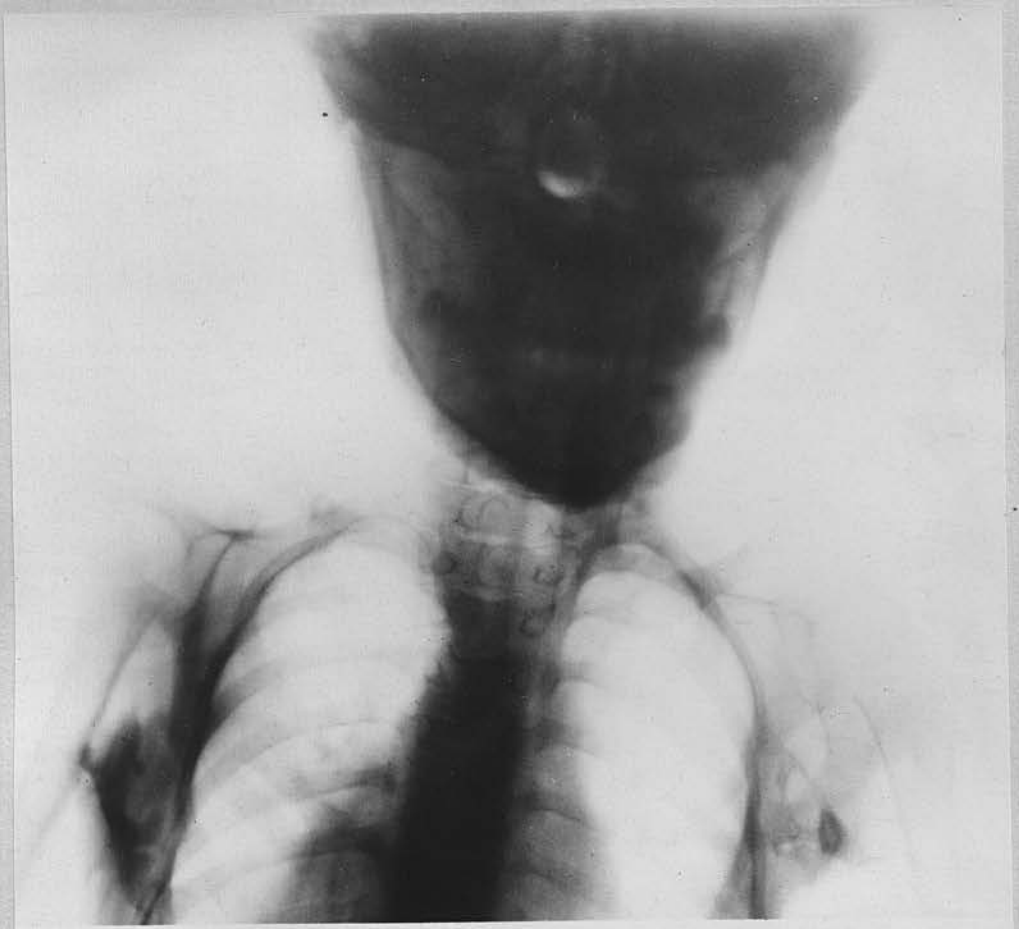
The child's normal attitude-note the position of the hands.

The legs are entirely unaffected, and there is no apparent diminution of their muscular power. There are present in the great toes the scars of the operations which were performed on the toes. The great toe is broader than, and turned under the other toes; but its overall length is less.

There was at this date no spinal curvature, but on 26.1.25 there was slight but definite lateral curvature of the spine to the right, of quite recent origin. The curvature of the head forwards appears to be due to the contraction of the tissues under the chin,/

chin, and not to curvature or kyphosis of the cervical spine. There is felt underneath the mandible a mass of bone, which is greater in degree to the right of the middle line. This mass seems to occupy the position of the Digastric muscle, and the lower jaw is slightly pulled inwards; the result being that the lower teeth come to lie at a greater distance than normal behind the upper, when the mouth is closed.

To illustrate the retraction of the lower Jaw.



Showing that the Masseters are not involved.

To show in particular the bony mass in the abdominal wall. (p. 44).

There is diminution of the normal aperture to which the mouth can be opened, but it is difficult to find any evidence of involvement of the masseters.

On the forehead at this date there were two swellings, each about the size of a florin, definitely circumscribed, and not tender. These were the result of trauma. There is a very hard swelling, about the size of a pea, on the scalp, at the junction of the Right Parietal and Occipital bones.

The right Sterno-mastoid muscle seems to be replaced by a band of bone; densely hard, and exactly following the situation of the muscle. The left Sterno-mastoid is affected in exactly similar fashion, although the process in this case is present to a much less severe degree.

On the anterior aspect of the chest it is seen that the Pectoralis Major muscles on both sides are the seat of a similar change, the whole length of the muscle being the guide for masses of bone, which bind the arms tightly down upon the chest wall; this process having resulted in a greater degree of limitation of movement on the left side than on the right.

There is present on the right side a bony mass which extends from the anterior axillary fold down the right side of the Thorax 1" external to the line of the Internal Mammary Artery and from ½" - ¾" thick, curving/

curving at one point to join the last Costal Cartilage; and then running downwards in the abdominal wall to a point opposite the umbilicus; at which point it has a protrusion about the size of a walnut. At a point 1" above and 1" internal to the Anterior Superior Iliac Spine it turns sharply outwards to gain attachment to the Anterior Superior Spine. The arms are both affected, but not the forearms or hands.

The left arm shows the osseous change in its most marked form in the Biceps muscle, forming a sharp ridge of bone extending down almost to the Cubital Fossa.

The right arm has several swellings upon it, particularly upon the postero-lateral and lateral aspects; the largest of these swellings occupying the position of the Triceps muscle.

To show the posterior aspect of the Right Arm.

Note the extreme degree of immobility of the Left Arm.

The Posterior Aspect of the Trunk.

Commencing above, there is a large rounded swelling, hard in consistence, at the level of the third Dorsal vertebra, and extending as far down as the lower Scapular border. It is about 2½" in diameter. Immediately below this swelling is a relatively soft swelling with separate very hard nodules felt on deeper palpation. The remainder of the swelling over these nodules is soft and fluctuating and the skin overlying them discoloured. Practically in the middle-line, over the 6th and 7th dorsal spines, is a large swelling, densely hard, 1" in diameter. Immediately below this is another swelling which is continuous with a diffuse bony chain down the left side of the upper portion of the thorax posteriorly, and which joins at its lower extremity a large mass of bone which runs up and down each side of the vertebral column. This terminates on the left side in the Lumbar region, and forms the largest of the bony masses throughout the child's body. This is an irregularly shaped mass of bone which appears as a swelling about 2½" long and 1" broad at the level of Lumbar vertebrae 3 - 5; and as a smaller portion of the same mass lower down near the Sacrum.
On the right side there is a small but very hard lump at the level of Thoracic vertebra, and another, also very dense, at the 6th lower Scapular Border.
There/

There is as on the left side a bridge of bone down the right side, terminating in a trefoil shaped mass of bone over the Ilium.

Illustrates the entire freedom from involvement of the lower limbs.

26.1.25.

The changes noted were these:- The masses of bone already referred to on the right side of the body had almost entirely disappeared; and the soft swelling/

swelling on the left side was now replaced by an exceedingly hard bony mass in the same situation. The arms were capable of greater movement, and the legs were still quite unaffected. The swellings on the forehead had gone.

The patient was again examined on September 14th 1925, and a very remarkable degree of improvement noted.

The child has grown very fast in the last year and is mentally in advance of a normal child of his age. He is in high spirits all the time and runs about and plays vigorously. He has learned to perform many complex movements by adroit use of his body and bending of his legs (which are still unaffected) to compensate for the still relatively fixed spine.

There is striking improvement on examination. Not only is the disease-process apparently at a standstill but it is definitely regressing. The bony masses in the upper part of the back are now represented only by a small flat plaque of bone which moves under the fingers. The apparently solid bar of bone on the left side is now divided into two.

There was marked improvement in the extent to which the arms could be moved. He can now separate the hands for a distance of 10-12 inches and his arm movements are facilitated by the fact that the mass of bone in the Biceps muscle is now only half its former size. Lumps still appear after a fall, but not otherwise. They do not now appear, however, ever to proceed to bone formation.

CASE II.

BESSIE RICHARDSON.

Age:- 4½ years.

Address:- 50 Burnside Street,
Alvaston, Derby.

Date of examination:- September 1923.

Birth place:- Derby.

Family History.

Patient's mother is alive and well. Patient's father is alive, healthy and has no deformity or abnormality.
Two elder brothers, both perfectly healthy, normal boys.
Nothing of note in the family history on either side.

Previous Illness:- Measles, chickenpox.

Present Illness.

The confinement was a normal one, and the child was apparently normal at birth except that the mother noticed that both great toes were very small. Dentition and walking were not delayed. When a fortnight old a swelling was seen on the left side of the neck, which was not tender but caused the child to hold her neck awkwardly and slightly to one side. This condition was treated by massage. The head became slowly more and more approximated to the chest/

chest and rotated to the right.

The next swelling to appear was on the back of the head and, very shortly afterwards, five others distributed over the scalp. These did not inconvenience the child in any way and apparently gave rise to no pain.

The torticollis became steadily worse and was treated operatively.

Three months later there appeared a hard reddish swelling over the upper three dorsal vertebrae, apparently typical of Pott's disease of the spine.

The condition at this time was treated with a poroplastic jacket. Two months later the swelling had entirely disappeared, with the exception of a hard small nodule. The occipital swelling was now much larger, and there had commenced, in addition, swelling of the muscles in the right supraspinous region, and from the inferior angle of the right scapula to about the 7th rib in the mid-axillary line. There was now definite limitation of movement of the arms. A month later there were felt distinct hard masses in the situation of the digastric muscles, and also in the axillary folds.

Showing the early degree of Torticollis.

From this time onward the progress of the disease was typical of Myositis Ossificans Progressiva, the occurrence at varying intervals of time, of semi-soft swellings, always confined to the dorsal aspect of the trunk, and terminating eventually in lumps of bony hardness. These lumps in some instances were very sharp and in one or two instances ulcerated through the skin and discharged a chalky debris which, when it had ceased discharging, left the lump diminished in size and the skin speedily healed over the site of the ulcer. The head became progressively more and more drawn towards the trunk and naturally a considerable degree of spinal curvature, especially in an antero-posterior direction, resulted. She kept the head rotated to the left; as it will be seen she had commenced to do at the time of the earlier photograph.

Condition on Examination:- July 1924. Aet. 5½.

It is remarkable to note how bright in spirits and how vivacious a child with this malady can be. She is lively, runs about the house, missing obstacles in the way with great skill although she cannot turn her head to see which way she is going. She is perfectly intelligent, and goes to school with the others. Her attitude when standing up accentuated the marked drawing down of the head: the cervical spine/

spine is almost at a right angle with the remainder of the spinal column. Her face is turned upwards and to the left. The fingers and hands, as are also the forearms, are free from deformity of any kind.

The abdomen seems prominent by comparison with her rather narrow, flat chest.

The legs, as in the first case, are entirely unaffected; and there is no diminution of their muscular power.

There is a fair range of movement of the arms.

There is a definite spinal curvature, and, in addition to the antero-posterior curvature of the cervical/

cervical spine, there is a well-marked Scoliosis to the right.

There is present, bilaterally, the typical malformation of the great toes - the great toe is considerably shorter than the second, and there is also present a moderate degree of Hallux Valgus.

There is happily no involvement of the masseters, and the child can phonate and swallow perfectly, in spite of the awkward position of the head.

The anterior aspect of the trunk is singularly free from the disease - there are none of the lesions on the front of the chest except in the axillary folds, as above mentioned, and the abdomen is also free from them.

The posterior Aspect of the Trunk.

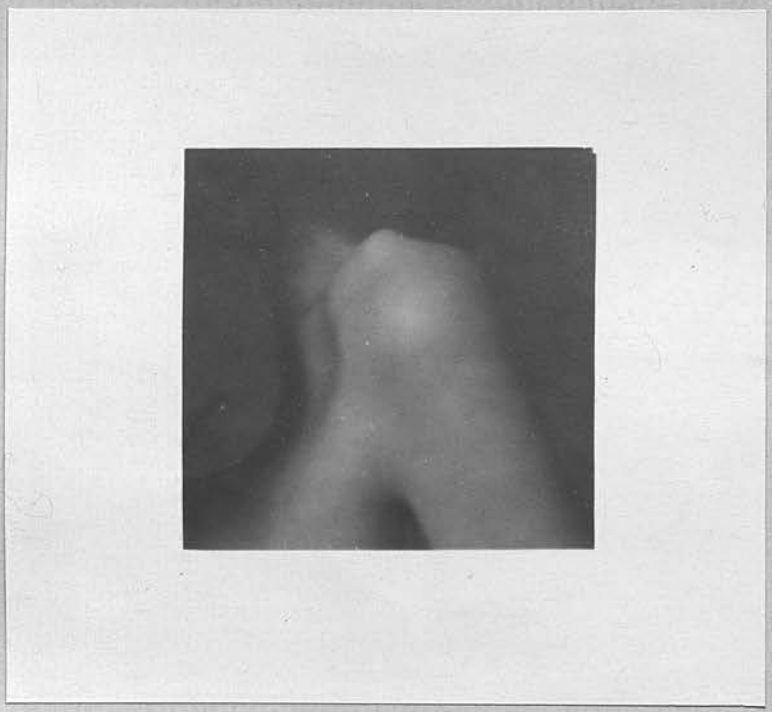
It is here that the disease has been most active. Commencing above, there is a mass of remarkable size and hardness, occupying a position roughly corresponding to an area extending from the inferior angle of the Right scapula, and somewhat external to it, to a point about 3 inches from the vertebral spines at the level of the 9th Dorsal Vertebra. This mass terminated at its lower end in a nodule of remarkable sharpness which bids fair to burst through the overlying skin. (It subsequently did so.) The mass proper consists of a dense bony structure with, as it were, two bosses superimposed; one in line with the inferior angle of the scapula and one 2 inches anterior to and above this.

Showing a nodule almost at the point of ulcerating through the skin.

In the mid-line of the back there is a mass of bone, broader above and narrow below, which commences somewhat diffusely about the 6th Dorsal vertebra and runs almost vertically downwards for about 3 inches, when it becomes a thin, intensely hard, ridge of bone running downwards and slightly to the left of the middle line to the level of the 1st Lumbar vertebra where it again becomes diffuse, joining a hard plate of bone in the muscles of the lower lumbar region. Below this again are several smaller, less well-defined swellings occupying a position over the Lumbar/

Lumbar vertebrae.

On the left side the swellings are not so manifest. Commencing above there is a semi-diffuse but hard swelling over the position of the left acromion. (This also shows the hollowing of the thorax which has followed the long-standing mal-position of the head and neck.)



Below this there are several masses scattered here and there throughout the musculature of the back. Three such lumps occur in triangular form, one just below the inferior angle of the left scapula, and two more immediately below it. Below, the left side is invaded by the diffuse mass or plate of bone already described as commencing in the middle line.

Note the marked degrees of spinal Curvature – Kyphosis and Scoliosis.

Subsequent History of the Case:-

During the last year there has been substantially no change in the features of the case, except that she took more and more frequent attacks of breathlessness, though her spirit was remarkable and she would run about in spite of this. However an attack of pneumonia supervened, and to this she succumbed in August, 1925.

As in my other case, apart from febrile intercurrent disease, no rises of temperature were ever recorded.

Introduction to Abstracts of Cases, not hitherto published.

I would desire to place on record here abstracts of some further cases which have not hitherto been published in this country. My reason for so doing is in order to contrast some of these cases with the foregoing, in some of which it was well-nigh impossible to differentiate between Myositis Ossificans Progressiva and the allied condition Calcinosis Multiplex Progressiva Interstitialis Ossificans, as it has been aptly termed. Some of the cases to be quoted are undoubtedly of this nature; in others the diagnosis remained uncertain; and others are true Myositis Ossificans Progressiva. My object is therefore to present the case-histories of the two allied diseases close together, in order that they may be the more readily compared with one another. The first case of the kind appears to have exercised the mind of Dietschy in 1907, who refers to it as "a peculiar general disease with predominant affection of musculature and integument."[31] The next paper and recorded case was by Krause,[66] who, it will be recalled, had already described in 1909 the lesions of Myositis Ossificans Progressiva with Trappe in 1907[67]. He was evidently also impressed with the differences between/

between the disease-picture of Calcinosis Interstitialis and Myositis Ossificans Progressiva in its usual form, and emphasizes this in renaming the condition Calcinosis Interstitialis Progressiva et Regressiva. Since then papers have followed, in 1910 (Tilp[114] and Versé's[116] papers); by Takasaki[111] in 1920, by Lohr[73] in 1922, and by Szenes[110] in 1923.

DIETSCHY[31]:- In this paper Dietschy describes the case history of a girl of 12 years. The commencement of the disease was somewhat indefinite. A wound on the knee seems to have determined the start of the process, and then without further trauma a fresh wound of the leg appeared at 9 years of age.

In the same year patient was admitted to Hospital suffering from contractures in the arms and legs and with marked muscular atrophy. Over the left great Trochanter there issued from a fine perforation at the summit of a flat tumour, thick white creamy masses, consisting of Calcium Carbonate.

The X-Ray photographs revealed considerable calcareous deposits over both Trochanters. Also in the popliteal space there were calcifications corresponding to the course of the tendons. Fine perforations and discharge of Calcium Carbonate masses also occurred in the arms.

The post-mortem and microscopical findings will be/

be referred to later. Note that there is no mention in this case of microdactylia or other congenital abnormality; and also the later age of onset.

KRAUSE.[66] heads his paper "on Calcinosis Interstitialis (progressiva et regressiva) a new disease-picture", and refers to his previous report of the case which he described with Trappe in 1907.[67] In the present paper he summarizes the case and states that at that time his diagnosis was one of Calcinosis Interstitialis Progressiva, assuming it to be a preliminary stage of Myositis Ossificans Progressiva. The patient was a female, and the onset in the 2nd decade. Family history negative. She is described as having become gradually stiffer, due to extensive calcification of her muscles. Two years later the disease appeared to be, and was diagnosed as, Myositis Ossificans Progressiva, a diagnosis which appeared to be justified by the continuous advance of the disease and by the X-Ray pictures also. There was demonstrated in a focus of softening the presence of large quantities of Calcium Phosphate and Carbonate.

Slight improvement took place in the power of movement in 1906, i.e. 5 years after the onset, but it was not until August 1907 that definite improvement was noted. She is now said to have been able to raise her arms above her head. During the following two/

two months there were spontaneous evacuations of calcium from hard nodules, at first on the knee, later from the biceps and acromion.

The author therefore abandoned the diagnosis of Myositis Ossificans and reverts to that of Calcinosis Interstitialis. To this he suggests adding "Progressiva et Regressiva" and finally stated that this is a new disease-picture, having nothing in common with Myositis Ossificans.

In this case the absence of microdactylia is definitely stated.

TILP[110] demonstrated a case of extensive Calcinosis occurring in a 17 year old girl in whom the disease had begun at the age of 12, with disturbances of gait and hard places under the skin of fingers, arms, thighs, and back. Both anterior axillary folds were stiff and firm; and calcareous deposits were present in the fingers, thighs, calf of legs, buttocks and back. Ulceration of the skin had ensued at some points. Some of the deposits were in masses, others in broad plates in the subcutaneous tissue; others followed the sheath of the sciatic nerve.

VERSE,[116] quotes a case in a male, 17 years of age; in whom the onset was 2½ years previously without accompanying pyrexia or other symptoms. Hard, calcareous/

calcareous nodules formed under the skin and between the muscles. These increased in size and finally by disintegration and softening discharged lime salts. Considerable emaciation, contractures, and great muscular atrophy resulted. The calcareous masses were in this case described as forming a regular coat of armour on the sides of the trunk; a description which would not be inapt in the case of Myositis Ossificans.

TAKASAKI.[111] Case I. Male of 16; onset said to follow an injury to the lumbar region in childhood. At 10 years a hard lump was discovered to the right of the 1st Lumbar vertebra; quite painless. The following month induration of the Right Trapezius commenced; limiting the movements of the right arm. There followed induration of the left half side of the trunk, nape of the neck, and on each side of the cervical spine. The movements of both arms and trunk became progressively more difficult and both Pectorales majores became hard. The whole course of the disease was painless and afebrile.

On examination the child was well-nourished. The neck was held somewhat to the left. Both sterno-mastoids felt hard; at the sternal origin on the left side there was felt a bone-hard tumour. (Note - this confirms the findings in my cases, in both of which the/

the Sterno-mastoid muscle was ossified: the French writers repeatedly state that the process in the case of the Sterno-mastoid never passes beyond the stage of fibrous induration). The vertebral column was quite rigid. The inferior angle of the scapula had apparently fused with the ossified soft parts immediately underlying it. On both sides of the vertebral column broad, bony-hard masses stretched from the Iliac Crests up to the 6th Thoracic vertebra, on which were other protuberant masses of bone.

Another bony mass followed the intercostal space between the 9th and 10th ribs.

The overlying skin was movable over the tumours and felt normal.

The respiratory movements were greatly impeded by involvement of the muscles of the chest wall.

Hard masses were felt in each side of the abdominal wall.

The movements of the shoulders and arms were greatly limited.

Both big toes were stated to be irregular but no true microdactylia was present.

The lower extremities, as in my own cases, were free from the disease. Blood examination showed Eosinophilia and Lymphocytosis. Blood Wassermann negative.

TAKASAKI. Case II:- 19 years old girl, negative family history. At 8 years had serious fall on to her back. After one week, swelling and induration to right scapular region, outer side of right arm, and nape of neck. Swelling disappeared, leaving induration and limitation of movement of the head and arm. A similar process followed in the left arm. Rigidity of the trunk ensued some time later. Forearms and legs remained quite unaffected. Well-nourished. Neck held towards the left. Both Sterno-mastoid muscles hard and prominent. The vertebral column was rigid and she had a Scoliosis to the left side. There was on each side of the vertebral column a mass of bone stretching from the Iliac Crest to the Inter-scapular space. Ossification of both anterior axillary folds was present. The thoracic muscles were much involved and respiration correspondingly impeded. No microdactylia. Again Lymphocytosis, Eosinophilia, and negative Wassermann.

LOHR.[73] Male, aet 20; onset 4½ years before. Family History negative. No trauma. Attack of "Rheumatism" in neck, back, and left arm. Swellings appeared and disappeared, the affection gradually spreading. No fever. General health remained good.

The whole cervical musculature and the upper part of/

of the left Sterno-mastoid were transformed into a mass of bony hardness. Confirmed by X-Ray examination. Part of this tissue was removed. The result will be referred to later, along with other pathological data.

SZENES.[110] Case of a girl, aet 1 year and 4 months, with healthy parents. One brother died from Congenital Pyloric Stenosis. Patient had bilateral Hallux Valgus and suffered from multiple, oedematous, firm swellings; throwing shadows akin to Calcium radiographically. The blood Calcium content was ascertained in this case and found to be 32.3 mg. %, the normal in the infant being stated as 20.7 mg.%, thus showing a considerable increase.

VIII. CRITICAL DISCUSSION.

A. PATHOLOGY. The ultimate state to which the disease progresses in the relatively rare instances in which the individual affected has lived to adult life is best seen by referring to one or other of the adult skeletons. There are of these some seven altogether; one in the Museum of the Royal College of Surgeons, London; another in the Pathological Museum of

of Manchester University, of which a description was written by Prof. J. Lorrain-Smith[75], and three specimens in Strasbourg. There are two in Ireland.

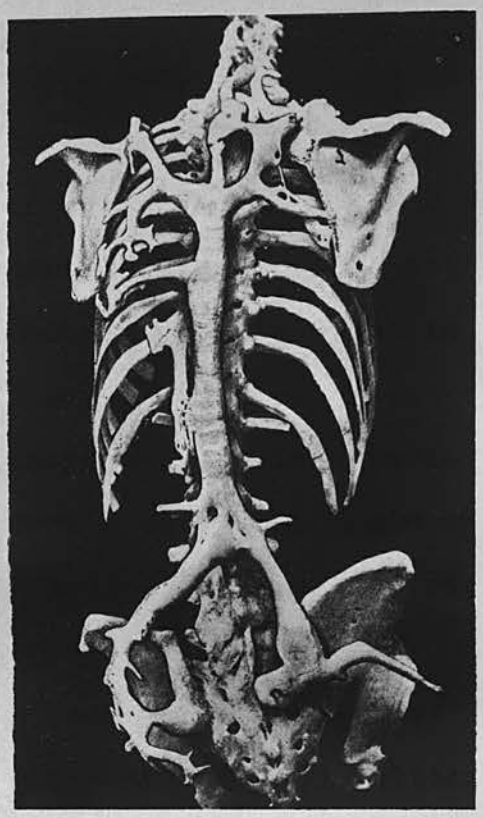
The accompanying photograph, kindly lent by the Department of Surgery, and copied by kind permission of Prof. Wilkie, Edinburgh University, of an Indian case, is sufficiently illustrative of the condition.

It illustrates many of the salient features of a fully-established case: it can readily be imagined how immobile this disease renders the subject; the presence of a continuous band of bone from the occiput to the pelvis is only found in the very late stages of the disease however. More commonly the lumps remain discrete for a long period of time; forming as it were a potential chain which may at a later date fuse and eventually give rise to the condition portrayed here.

There have been many attempts at description of the bizarre arrangement of the additions to the bony skeleton - in one of the earliest cases which had been under observation for 30 years Lendon[69] quotes:-
"The scapulae ..... their inferior angles being soldered by a buttress of bone on the right side to the 8th and 9th ribs and on the left side to the 7th and 8th ribs ..... and in addition they are attached to the vertebral column by a somewhat similar ossification of the Latissimi in nearly the whole of their length ..../

length ..... forming a sort of Carapace to the Erectores Spinae lying beneath".

The difficulty of portraying the ramifications of the bony processes has been compared to describing Calypso's grotto!



Pathological Anatomy.

In addition to the masses of bone of varying shape and size which in the skeleton all seem to be attached to the bony skeleton, there have repeatedly been found masses or plates of bone lying loose, apart from any skeletal attachment, when the body/

body was dissected. This is an important observation in view of the very difficult pathogenesis of the condition. This was noted by Lendon (1887) and in his case loose masses of bone were found post-mortem in the Pectorals and the Peronei.

Spinal curvature appears to be a not uncommon accompaniment of the condition, and generally takes the form of Scoliosis.

The tissues affected:-

From a study of the post-mortem noted of this condition, we are led to believe that scarcely any of the striped muscle tissue is exempt from attack.

The larynx, tongue, sphincters, in addition to the heart and diaphragm, have never been found to be involved, nor, I would add, the muscles of facial expression.

The ligaments have often been found completely ossified; as also have tendons and aponeurotic sheaths. In one case the ossification was complete in the Interosseous membrane between the tibia and fibula. There are also records of the ossification having affected the capsule of the hip-joint; thus adding another to the ways by which this disease may bring about immobility of the joints. Apart from this it does not seek out the articulations, and the articular cartilage is generally found smooth and unaffected.

In/

In some cases the hyaline cartilage was said to have undergone fibrous change and to be slightly uneven.

The ocular muscles are sometimes not spared, and plaques have been noted in the choroid, causing amaurosis. (Gazette des Hôpitaux p.1671, 1905) The ultimate form of the bony masses will in many instances be found to correspond with the shape of the affected muscle.

The extent to which any given tissue suffers most varies greatly, in some cases the disease appears to have a predilection for tendons or ligaments, more commonly for the muscular system.

It is almost invariable to find a greater or less degree of atrophy of the bones of the skeleton, including those unaffected. In some cases actual decalcification has been observed.

The Nature of the Bone-formation in Myositis Ossificans.

The bone occurs, as has been noted, either in muscle and becomes attached to the adjacent bony skeleton; or remains unattached and free. It has sometimes been noted to resemble very closely Exostoses as ordinarily seen, and thus to form thin spicules originating, as it were, from bone. In consistence it has been found to vary from a bone of remarkable hardness to a soft, almost spongy structure; covered with/

with a still softer layer; this evidently still in process of development. This latter form has been observed to be perforated by large vessels and nerves, as if almost designed to protect these structures; ossification has been noted in their sheaths.
Also there has been found a finely reticular sponge work, traversed by innumerable foramina. In some cases the bone has been so soft as to cut easily with a knife (Weil and Nissim).

Examination of the bone found:-

The earliest record one has been able to find states that in 1846 Mr John Goodsir examined "a portion of bone about 2½" in length which was found surrounded by the muscular fibres of the left biceps flexor cubitis" and found to contain all the elements of true bone. This appears to have been a genuine case of the Progressive form of the disease, having started at 8 months.

That the bone, when fully formed, is of the nature of true bone seems undoubted; as all subsequent examinations have confirmed the above findings; of late years however, the tendency has been to examine rather the earlier lesions in an endeavour to clear up the pathological process at work and the reaction of the tissues to it.

A definite statement is made by Thompson

(Proc./

(Proc. Roy. Soc. Med. 1909-10, Vol. 3, Clin. Sect., p.152). "It (the bone in myositis ossificans) contains a Haversian canal system." And by Mayo, and Hawkins[48] who describes the bone as presenting the structure of the osseous tissue, formed of lamellae of compact tissue disposed around Haversian canals.

Pathological Anatomy of the early lesion.

This has been the subject of so many varying descriptions that one can only infer that the preparations must refer to widely differing stages of the disease; and as we know that various stages of the disease may occur in the same area of affection, this serves to make the confusion even greater.

An endeavour will be made to correlate some of these findings:-

The microscopical findings in all stages of the process go to support the view, now generally recognised, that the primary lesions of Myositis Ossificans Progressiva affect the Interstitial Connective Tissue and not the muscle fibres themselves. At the same time some observers have noted that at this early period of the disease the muscle bundles may appear somewhat oedematous but microscopic examination proves the muscle fibres to be normal; and the early stages of the process are seen as a proliferation of the interfibrillary/

interfibrillary connective tissue and its replacement by a young embryonic connective tissue network. This new cellular infiltration has been described as being most abundant around the vessels and particularly the capillaries, and by some much has been made of this in pathogenesis.

The next stage in the process consists in the organisation of this embryonic structure into fully formed and firm fibrous tissue - the Sub-acute character of the "inflammation" has now gone, and the tissue retracts and consolidates, enclosing and pressing upon bundles of muscle fibres as it does so, and covered by a layer of bundles of normal muscle-bands, according as to which part of the muscle is involved.

The muscle-bundles which persist in the heart of this new tissue, stand out by their colour, in the form of red streaks, on the homogeneous background of the newly formed fibrous tissue.

Sections made at the transition zone show that the firm new tissue is merged gradually into the interfibrillary connective tissue.

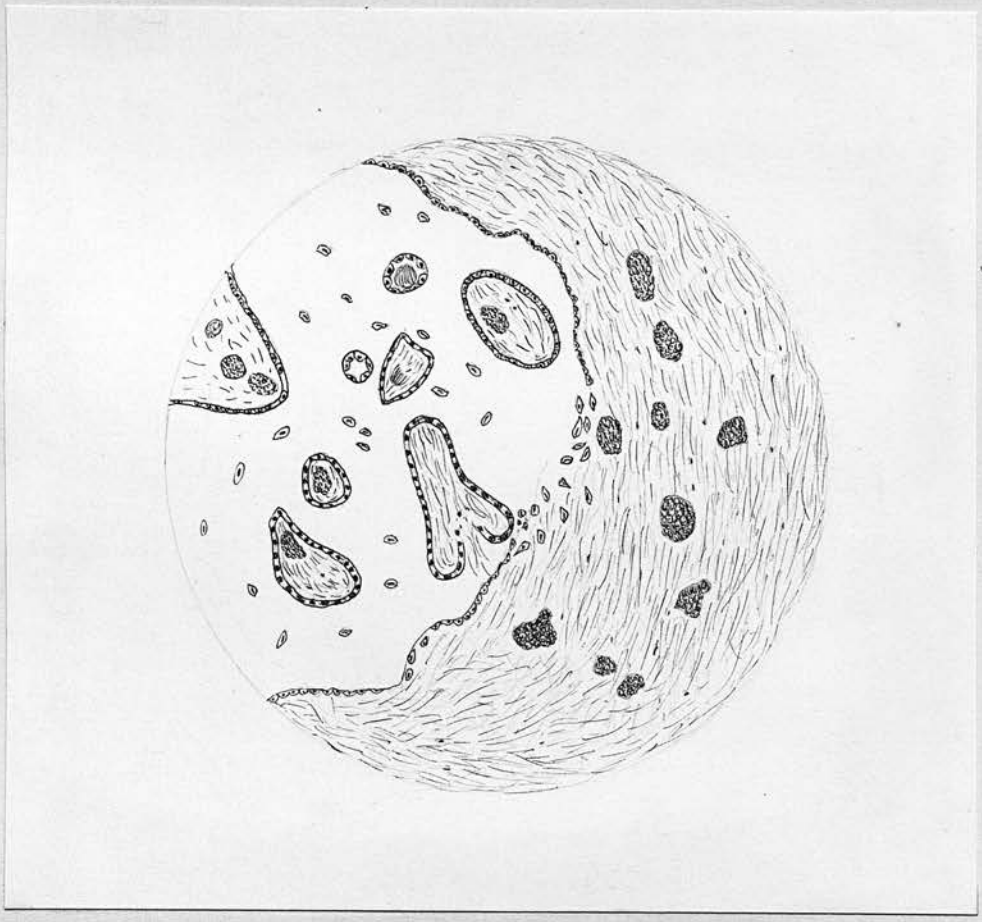
On examining the portions of muscle in the centre of the tumour one sees that the striated fibres alter in the direction of atrophy, with or without multiplication of their nuclei. They then lose their transverse striation/

striation while their longitudinal marking becomes exaggerated.

Some authorities lay great stress on the multiplication of the nuclei in these fibres; which may be so numerous as to form a sort of giant-cell system at certain places.

The transition zone between the normal tissues of the part and the change above described seems to be particularly rich in vessels, and several writers lay stress upon the cellular infiltration being peculiarly massed around capillaries.

In the very heart of the "tumour" may be seen atrophied muscle fibres with prominent nuclei but it is not long before they become disintegrated into a granular mass, only their nuclei remaining stainable.



They leave in their place little clefts or gaps which give to certain portions a finely spongy appearance.

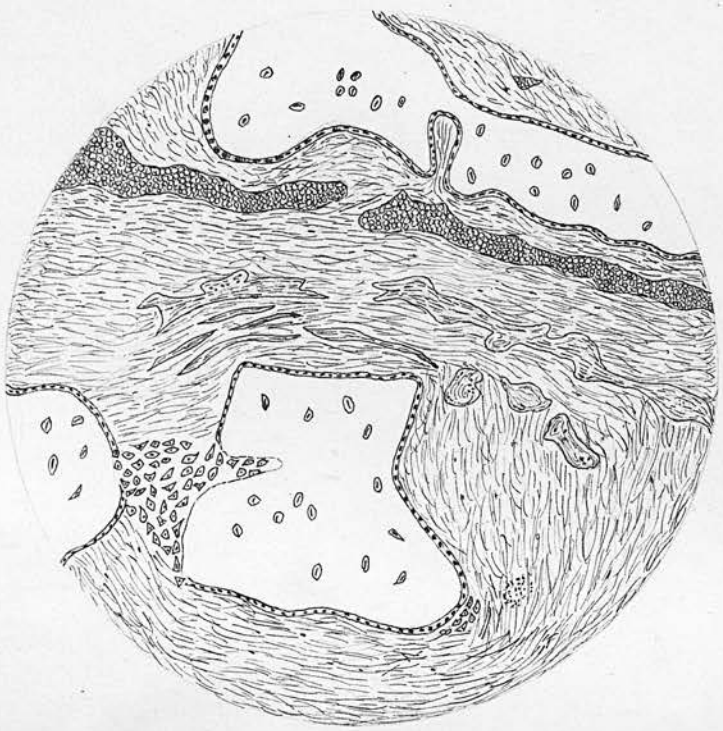
We also find large cell-elements, more rounded, which have the appearance of cartilage cells.

In some places the bands of connective tissue, ramifying and anastomosing between themselves, give the closest resemblance to bony structure. They are at this stage condensed but not yet calcified.

The cellular connective tissue elements are replaced by the little angular clefts, while embryonic cells, disposed in regular order, apply themselves to the thick bands remaining to form eventually osseous trabeculae.

Already at this stage Weil and Nissim have shown the existence of "une ébauche" or "rough draft" of cartilage and true osseous trabeculae. Hawkins[48], in an adult case of which preparations are in the Museum of St George's Hospital, found cartilage in an excised portion but regarded it as unusual.

Myositis ossificans may proceed no further than the stage of induration. This, the French authors agree, is the case in the Sterno-mastoid muscle. In other cases it ends with the formation of cartilage, which may persist or ultimately ossify.



The process of ossification is not seen simultaneously throughout the whole depth of the fibrous mass but commences at its centre where it may remain limited for a time. On section at this stage are seen:-

(a) The periphery - a superficial envelope of healthy muscular tissue.

(b) Next to this a zone of varying thickness of very dense fibrous tissue; which is below infiltrated between/

between the muscle fibres, especially in the direction of their length.

(c) A few more or less unaffected muscle fibres.

(d) The greater number atrophied, granular, fibrous or having suffered fatty degeneration.

(e) In the centre the osseous nucleus.

All the stages of the foregoing process may be found, not only in the same patient, but in the same muscle at the same time, hence the extraordinary variability in the appearance of the lesions to the naked eye, and their apparent power of movement.

The other muscles of the limbs are, as has already been stated, the seat of a greater or lesser degree of atrophy or it may be even undergoing a fibrous change. Others show, at the same time as the atrophy of their fibres, an interstitial fatty degeneration which has led some of the French authors to lay particular stress on this point as it accords well with their theory of myopathic origin of the disease-process, as an interstitial fatty change of this nature is frequently found in the myopathies to which they seek to relate Myositis Ossificans Progressiva.

In the case of the tendons, which as we have already seen, are not infrequently affected; between their constituent fibres an infiltration of embryonic cells takes place on the one hand continuous with the embryonic/

embryonic intramuscular cellular tissue and on the other continuous with the surface of the periosteum. These cellular elements become organised, ossify, and give rise to osseous bands, uniting intimately with the periosteum and the bone which has been formed in the fleshy body of the muscle substances. In this way also are formed the osseous structures which are able to solder together two neighbouring bars of bone. It is in this way that the vertebrae are sometimes transformed into a rigid bar of bone.

The bones in this condition almost always suffer from a degree of decalcification, as if the pathological calcification in the muscles entailed a compensatory decalcification of osseous tissues. This has been so marked in some cases as to lead to fractures (Munchmeyer[84], Opie[90]), and osteoporosis of the whole skeleton has been observed (Lendon: Manteufel). A remarkable case is on record of a man who had at one and the same time Myositis Ossificans generalised throughout his muscles and Osteomalacia in which the Calcium appeared to have left the skeleton and been carried to the muscular system, there to help in the formation of osseous tumours.

In all the post-mortem records one has been able to review the viscera have been found normal, except for those in which intercurrent disease had determined

a/

a fatal issue. In these the occurrence of Tuberculosis of the Lungs is constantly recurring, sometimes as a chronic lesion, but not infrequently as a Tuberculous Bronchopneumonia. An acute attack of Pneumonia is very often the final illness and is predisposed to by the immobility of the chest wall.

London[69] examined the Cervical spine and found no abnormality. The brain, the peripheral nerves, and the spinal cord have been repeatedly examined and found healthy, except of course in those cases where spinal cord lesions were also present in addition to the Myositis.

B. DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS.

In the early stages of the disease recognition may prove a matter of some difficulty, especially in view of the fact that the condition may, as we have seen, at first simulate simply an ordinary congenital torticollis; or in other cases simple glandular enlargement in the neck. The difficulty is added to when we recognise the fact that these early swellings may disappear completely and leave no trace of their presence. However the recurrence of swellings, apparently painless, without local cause or symmetry, should make us at least consider the possibility of this disease; and if these are associated/

associated either with microdactylia or other congenital abnormality of the toes or fingers the diagnosis is materially strengthened. The occurrence of a swelling, or group of swellings, larger than would be anticipated from the simple results of a fall would put one on one's guard as to the true nature of the underlying disease. These difficulties of course largely disappear when the stage of bone-formation is reached.

Its occurrence in the very young infant might possibly lead to confusion with Cephalhaematoma, especially if the tumour is first noticed immediately after instrumental or difficult labour. It may be a help in distinguishing however to note that Cephalhaematomata are, in the vast majority of cases, confined to the limits of the parietal bone.
A similar difficulty might conceivably arise where a "Sterno-mastoid Tumour" is observed in the early weeks of life. The difficulty is the greater in that the Sterno-mastoid Tumour of infants may vary in size from time to time; is hard and painless, and may cause the head to be inclined to one side.

In these infrequent cases where Sterno-mastoid Tumour and Cephalhaematomata co-exist, the resemblance between these two conditions and early Myositis Ossificans may be very close.

In the early stages of the disease the condition may be mistaken for a Rheumatic manifestation and this is/

is easily understood when one remembers its frequent onset in the Sterno-mastoid and deeper muscles of the neck. If this is followed, as in several cases, with a myositis affecting other muscles - as in the cases involving the whole shoulder-girdle,- the resemblance to Rheumatic infection may be very close. The possibility of a Rheumatic affection becoming chronic and leaving behind it a degree of induration and nodular thickening of fibrous tissue origin is to be remembered, and some writers have gone so far as to regard this as the forerunner of the more serious affection.

Still considering the early stages, the diagnosis may sometimes be made only with the passage of time from the generalised and progressive form of Myositis Fibrosa, a rare disease of muscle of which the principal characteristics and points of resemblance to Myositis Ossificans Progressiva are:- in at least some cases the process has started in the Sterno-mastoid and from thence spread to neck, back, and intercostal muscles, which would serve as a typical mode of spread for Myositis Ossificans Progressiva.

Microdactyly of the great toes has been observed.

There is atrophy and degeneration of muscle-fibres; and a well-marked interstitial change.

There is a marked tendency to contractures of the limbs.

The abdominal muscles may be affected.

The/

The principal points of difference are:- Myositis Fibrosa is commoner in girls and tends to commence on the whole later in life than Myositis Ossificans.

There have never been found in Myositis Fibrosa lesions approaching in hardness or density the bony growths found in Myositis Ossificans.

The lower limbs are usually attacked first - which is in direct contrast to Myositis Ossificans.

In a few cases pain appears to have been a prominent feature in Myositis Fibrosa - it is strikingly often absent in Myositis Ossificans.

The Sterno-mastoid is frequently much shortened, again causing torticollis.

The abdominal muscles are affected in a greater proportion of cases than in Myositis Ossificans.

There appears to be in Myositis Fibrosa a certain inherent tendency to recover, which may be aided by appropriate treatment; this cannot, more is the pity, be said of Myositis Ossificans to a similar extent.

There has also to be considered the very rare disease Dermatomyositis; in which not only the muscles themselves, but simultaneously the skin and subcutis are involved. This condition is regarded by some as the first stage of Scleroderma. It is characterised by swelling of the affected muscles plus a firm oedema of the subcutaneous cellular tissue. The skin and subcutaneous/

subcutaneous tissue reactions in Myositis Ossificans are purely the result of pressure from the activity of the underlying structures.

It is also accompanied by sweating and a curious accompaniment - enlargement of the spleen.

The whole course of the disease is more rapid, and comes fairly soon to a fatal issue. It is on this feature of a more rapidly progressing rather steadier course than Myositis Ossificans that considerable importance must be laid in diagnosis.

Finally it is capable of attacking not only the skeletal muscles but also the muscles of respiration and the larynx, which is never the case in Myositis Ossificans. It has never been known however to affect the joints.

From Polymyositis Haemorrhagica:- the two diseases are not likely to be confused if one keeps in mind the less "acute" nature of Myositis Ossificans: there is little or no fever, and never purpuric or other haemorrhagic manifestations. And in Polymyositis cardiac phenomena are rarely absent.

Considerable difficulty must arise from cases of Calcinosis Interstitialis Multiplex Ossificans (Progressiva et Regressiva) using this term in the sense that Krause used it, and not including cases of Scleroderma.

This/

This disease-picture is dominated by the fact that the lesions, though extremely hard, contain, or at least many of them contain, a greater proportion of salts of Calcium than they do fully-formed bone. And further, that in a considerable number of cases these nodules may ulcerate through the skin and discharge their chalky contents. In one case we read: "the calcareous mass formed a regular coat of mail on the sides of the trunk and anterior abdominal wall" - very like Myositis Ossificans Progressiva. 114
But the difficulty is made still more manifest when one recalls the fact that in the second of my two cases the nodules ulcerated through the skin in the mid-dorsal region (and therefore not the result of extrinsic pressure) and discharged chalky, homogeneous debris. This case presented, as we have seen, every other feature of typical Myositis Ossificans Progressiva.

Judging by the small number of cases of true Calcinosis Interstitialis Ossificans Multiplex which I have been able to trace, this disease (if we are to regard it as a separate one) is commoner in girls. It also appears later in life and there is not the same marked tendency to emaciation as in Myositis Ossificans. There is however marked co-incident muscular atrophy. Congenital abnormalities are generally absent.

It may not be out of place here to refer to the fact that, as in Myositis Ossificans, the internal organs are never affected directly. The similarity is the greater when one finds that all the microscopical descriptions of the affected tissues have gone to show that the primary seat of the disease-process is, as the name implies, in the Interstitial connective tissue of the muscles.

The accompanying changes in the muscles (atrophy, etc.) are said to be due to the inactivity forced upon them by the hindrance to their movement caused by the presence of the Calcium deposits.

It is noteworthy that one point of clear distinction from Myositis Ossificans arises - in Calcinosis the tendons and fasciae are never attacked.

The Calcium deposits, which are almost invariably amorphous, have been the subject of chemical analysis and have been found to consist mainly of Calcium Phosphate.

The spontaneous faculty of re-absorption which these Calcium deposits appear to possess is a valuable diagnostic aid; and may be apparently the only way in which certainty can be arrived at; as in Krause's case. There are however certain points of difference, apart from the age and sex incidence. The presence or absence of microdactylia is undoubtedly important but must not be taken as infallible.

Affection/

Affection of the skin is uncommon in Myositis Ossificans: again, not infallible.

The demonstration in a locus of the disease which has softened, of salts of Calcium; a rare event in Myositis Ossificans.

Radiography would be of assistance more in helping to determine whether there were actual congenital maldevelopment of the toes or thumbs rather than in distinguishing between the two conditions.

(It was in order to bring out some of the above points that case histories of some typical cases were quoted.)

In the late stages:-

From multiple exostoses.- Multiple Exostoses may generally be differentiated from Myositis Ossificans by the fact that they have each always a definite point of attachment to the bony skeleton. They do not appear loose in muscle as in Myositis Ossificans; and they are not infrequently of hereditary origin.

From Pott's disease.- That this is a very real difficulty is evidenced by the fact that the second of my two cases was so diagnosed and treated for some considerable time. The occurrence of a semi-solid swelling over the vertebral spines not apparently due to any local cause, and the fact that the child perhaps has some little difficulty in attempting to move the/

the back - all go to make the distinction so difficult that the progress of the disease may be the only criterion of the accuracy of our diagnosis.

C. PROGNOSIS.

The prognosis in a true case of Myositis Ossificans Progressiva must always be grave. These children only rarely reach adult life; the strain of puberty seems to tell heavily upon those who reach this age, and a span of from 10 - 15 years is the most one can expect after the onset of the disease. It is not so much that the disease is fatal of itself, but that it predisposes so to the invasion of other infections by the immobility it causes. This is particularly true of Tuberculosis. It is perhaps merciful that so many of the little victims of Myositis Ossificans Progressiva succumb to intercurrent Pulmonary Infection before they are called upon to suffer from inanition from involvement of the Masseters.

But we must be guarded, as we have seen, in giving too gloomy a prognosis. Improvement is possible not only in cases which are not true Myositis Ossificans but in those which are undoubtedly of this nature, though it is difficult to see how bone once formed can be absorbed. I am satisfied that in the first of my two cases considerable improvement is taking place spontaneously.

D. TREATMENT.

It has to be recorded at the outset that attempts at treatment of this condition are, to say the least of it, disappointing. No form of treatment yet devised appears to stay the progress of the disease, and what measure of recovery is possible appears to take place without our assistance or power to accelerate the process.

One fact is amply apparent both from one's own limited experience and from a study of recorded cases and that is that surgical interference is inadvisable. It seems to act almost as a fresh trauma - and that it may be followed actually by renewed activity of bone-formation seems to be borne out by the fact that an incision in the palm of an individual suffering from the disease has been followed by bone-formation in the cicatrix. (Elliott.[34])

A few so-called successes are on record but one wonders whether some of these may not have partaken more of the nature of "Calcinosis Interstitialis Progressiva et Regressiva". For instance, in one of the earliest cases - William Carey[51]. We are given an accurate description of the swellings, the induration, and ossification but the report adds: "with pain and bursting of the skin, oozing very thin digested pus." So that a subsequent note which records/

records the remarkable improvement, "by which he exchanged his ghastly hectic countenance for a healthy and athletic complexion", may in part be due to the natural regression of the disease. The treatment he had adopted was sea-bathing twice daily and rubbing with a piece of Quercus Marina immediately after bathing.

He is said however to have relapsed and again improved under this treatment, "combined with salivation and mercurial plasters".

A hardly less drastic mode of treatment has been tried of comparatively recent years. One observer, with perhaps more therapeutic zeal than discretion, instituted a diet designed to produce a condition analogous to scurvy in his unfortunate patient, no doubt having been impressed by the degree of softening of the bones which occurs in that disease. No change in the progress of the ossifying lesion was observed and one can hardly hope that a patient suffering from this disease, whose life is rather precarious at any time, would be likely to benefit from a regimen of this kind.

Many other modes of treatment have been adopted, but all with uniformly disappointing results.

To take first the methods of which one has had experience:- gentle bathing and subsequent extremely gentle massage of the limbs, while followed by no definite/

definite improvement, never appears to have done any harm; and in the mother's opinion is at least partly responsible for the slightly increased movement of the arms.

The same remark applies to the inunction of pure olive oil, and I would suggest that the good nutrition of the first patient's (T.S.) skin may be due to the fact that this has been systematically carried out.

Iodides in all forms were tried both internally and externally. A course of Cod Liver Oil was given over a prolonged period of time without apparent benefit.

Of other modes of treatment there are records of the extended trial of all the Iodide Compounds; Arsenic frequently; decalcifying acids - Hydrochloric and Phosphoric; Antimony. It is only fair to mention that the patient of Paget's who improved so much had been under treatment with Salicylates for years.

Various glandular extracts have been used, notably Thyroid, Thymus, and Adrenalin; all without success. One case of success has been reported following Anti-Syphilitic treatment. (Hawkins)[48]

Not a few authors refer with varying degrees of success of the use of Thiosinamin, which is prepared from Essential oil of Mustard and given in $\frac{1}{8}$ gr. to $1\frac{1}{2}$ gr. dose in capsule or hypodermically.

In one case quoted[14] which appears to have been a true/

true case of Myositis Ossificans - and to have resisted all other methods of treatment - (its subsequent course proved this to be the case) a daily injection of 1½ gr. Thiosinamin was given until six had been administered, and resumed later with, it is stated, a complete return to normal.

With such an encouraging report it is scarcely to be wondered at that other authorities made trial of this agent,[111] but that careful observer Takasaki reports that in one case in which it was used for a month the results were definitely unfavourable.

It is stated that the injection of Thiosinamin may cause transient nervous symptoms. A more potent reason for not employing this method of treatment is that one believes that hypodermic medication should if possible be avoided in children, and still more urgently one has records of a case in which hypodermic injections in a case of Myositis Ossificans were followed by bone formation at the site of each puncture.

Special methods have been adopted in some instances:- in two recorded cases the Parathyroid glands were removed - (109) and (70), doubtless on the assumption that their controlling influence on Calcium metabolism would be thereby abolished. In one of these[110] two parathyroid glands in the left side and extensive Thymus removal was performed. It is stated that improvement took place, lasting for a few months, followed/

followed by fresh exacerbation and fresh swellings.

Irradiation with Röntgen rays has apparently met with a degree of success in the hands of some workers. One would imagine that the greatest care would be required in the selection of the case and in the dosage employed, more especially if the treatment were undertaken early in life.

In 1921 Manuwald[78] stated that while he had been unsuccessful in one case in which he had tried this, 22 cases of Myositis Ossificans Progressiva were on record where it was "said to be successful". Horand[55] reported remarkable benefit from 26 exposures in a girl, aet 4, though the original foci of "calcification" were not modified.

With regard to suggested lines of treatment, one has had the advantage of having the opinion of Dr Rollier of Leysin to whom one is also indebted for some very valuable guide-posts to the literature of the subject. It is to him also, practically entirely, that the bringing into prominence of the possible relationship of Calcinosis Interstitialis Multiplex Progressiva and Myositis Ossificans Progressiva is due. Dr Rollier has had no experience of such cases but, with a view to attempting to restore the Calcium metabolism equilibrium, would have been willing to attempt the treatment of one of the cases (T.S.) with a few months natural heliotherapy. Unfortunately the opportunity/

opportunity has not afforded itself to make this hopeful experiment.

It is felt that almost all that we can hope to do is, first, to prevent, as far as possible, the occurrence of any trauma in a child who will subsequently develop the disease - and, secondly, to recognise the nature of the early lesions and refrain from surgical treatment.

I do not think that the gentle inunction of olive oil has done any harm in one of my cases, and if it has kept the skin nourished and supple it will have achieved some useful purpose.

IX. CONCLUSIONS.

It seems that only by a fuller understanding of the causal factors at work in this disease will progress in its treatment be made. In order to arrive at conclusions we must briefly survey the possible theories of origin:-

These have been very numerous and start with the view held by Virchow[118]. He believed that the lesions were analogous to, if not identical with, those found in Multiple Exostoses; and that all the bony masses invading the muscles had their origin from the bony skeleton and were therefore attached to it. That this view is no longer tenable is proved by the fact that there have repeatedly been demonstrated masses of bone free altogether of any connection with the bony skeleton and loose in the muscles.

Furthermore, the progress of Multiple Exostoses is altogether afebrile and steadier than Myositis Ossificans. Virchow sought to correlate this view and the existence of an "osseous diathesis".

At this point it may be appropriate to refer to the view that the disease is always secondary to detachment of, or other injury to, the periosteum. While it will not be denied that this is the commonest mode/

mode of origin in the Traumatic variety, there are too many well authenticated examples of the disease occurring where no possibility of a periosteal element being present existed. The case recorded by Parkes-Weber,[120] where bone formed in an incision scar in the palm, is a good example of this.

A number of observers have endeavoured at various times, notably Nicoladoni[86], to prove the existence of a causal relationship between disease of the central nervous system and the occurrence of Myositis Ossificans. One may recall here the ossifications which sometimes occur in Tabes Dorsalis, and draw an analogy therefrom, but on the other hand there have been numerous cases of Myositis Ossificans recorded where a careful examination of the Spinal Cord and other portions of the Central Nervous System has failed to detect any pathological change.

The latest author to add support to this view is Israel whose paper is briefly summarized elsewhere in this work, but before this Eichort revived and supported this view, bringing to light cases associated with Spina Bifida and Epilepsy for example.

Some French writers have sought to prove that the disease is at least related to the Myopathies and point out the somewhat similar age onset and pathology in/

in the early stages; the atrophy and fatty degeneration, as found in Pseudo-hypertrophic paralysis. Some have gone so far as to re-name the disease Amyotrophie Ossifiante Progressive. They cast doubts on the nature of the early interstitial cellular change, pointing out that the nuclei in children are already abundant, and ingeniously elaborate a theory which seeks to prove that the interstitial cells are not after all at fault but that it is by a metaplasia of the muscle cells themselves that the change is brought about. They admit that the presence of true bone is a difficulty in the way of full acceptance of this view, but this difficulty is abolished in one phrase - (speaking of muscle cells) - "ils ne sont pas incapables de remplir le rôle des ostéoblasts". There seems no need however to presuppose such a far-reaching metaplasia as this, in view of the clearer understanding now held of the pathology of the condition.

Recently it has been sought to prove that the process is fundamentally due to an inherent weakness of the terminal capillaries; permitting the escape of erythrocytes and regarding them as the primary exciting cause of the lesions. This is a view which will require further confirmatory microscopic evidence to prove the truth of - it may be noted in passing that in attempting treatment fresh blood has been injected subcutaneously/

subcutaneously and intramuscularly without the slightest effect either on the course of the disease or (as might be expected from the above) in stimulating bone production.

After reviewing these various theories we are forced to the conclusion:-

(1) that the disease must necessarily be congenital in origin, but that

(2) we are as yet uncertain of the stimulus to bone production.

The fact that the disease is congenital can scarcely be denied when we remember the existence in so great a proportion of cases of congenital deformities, generally the same deformity; and secondly the fact of the disease being present at birth.

Granting the presence of a congenital aberration of development - what are the possible varieties of this?

1. There is the view originally put forward by Sir H. Rolleston,[101] namely that the disease was due to a developmental disease of the mesoblast and points out that the subcutaneous tissue is never affected directly, dividing the developmental diseases of the mesoblast therefore into

1. Tegmentum - Molluscum Fibrosum
   Neuro-Fibromatosis
2. Skeletal - Myositis Ossificans Progressiva.
   Multiple Exostoses and Endochondromata.

The second view of the developmental origin of the disease is found in the view of Maunz,[79] who puts forward the view that in the "anlagen" or home of musculature, osteoblastic nuceli enter. They remain dormant unless the resistance of the muscle is lowered by some means, such as a trophic change and then assume their active form.

But what could more efficiently fit the facts of the case as we know them than the view of embryonic disturbance first put forward by Paget and perhaps more accurately phrased by Adami. These two similar views are that in Paget's view there persist undifferentiated mesenchyme cells, capable of becoming fibrous tissue, cartilage, or bone. In the slightly different view point of Adami the potential oestogenetic power is impressed not on some but on all the mesenchyme elements which are to go to form the connective tissues of the body.

These views seem to meet adequately our quest for an underlying cause. We have still to meet the question of how and why the lesions develop into true bone in Myositis Ossificans.

I would suggest that we are dealing here with a disorder of Calcium metabolism, and that it is a combination of the underlying factor above described plus this Calcium element which gives the clue to

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the disease.

Referring for a moment to the allied disease Calcinosis Interstitialis Progressiva which bears so many extraordinary resemblances to Myositis Ossificans as to be surely a guide to the pathogenesis of the other, we find that all authors, including those who have carefully summarized the work of others are at a loss to explain just why the deposits should take place at any given place in the muscle group any more than we are able to determine the more highly differentiated deposits in Myositis Ossificans.

There have been described cases in which Myositis Ossificans and extensive Calcium deposits have co-existed - a fact which makes us consider whether, in view of the fact that the body can convert Calcium deposits into bony structure (MacCallum - Text Book of Pathology, 1919, 184-185, and Dawson and Struthers[28]), the deposition of Calcium salts may not be in some cases an alternative mode of ossification to the usual endochondral type.

In Calcinosis the process appears to be one of an interstitial hyperplasia of connective tissue, followed by a permeation of this tissue by a fluid rich in Calcium - probably derived from the blood-vessels but what induces this fluid to deposit its Calcium salts out of their soluble state we are almost in ignorance. It is known, however, that deposits of Calcium occur more readily where a local alkalinity of the/

the tissues exists. What causes the local alkalinity in Calcinosis? This has yet to be determined.

We know, further, that calcium salts have a specific osteogenetic influence: may not therefore this be the forerunner of the ossifying process, whether in cartilage or calcified material? Or is the process in Myositis Ossificans always the result of metaplasia of fibrous tissue, cartilage, bone? That a direct metaplasia of this kind we know, may and often does occur.

SUMMARY.

In an endeavour to review the subject as a whole we see that the disease is in a sense mis-named, as the whole of the pathological process is enacted in the Interstitial Connective Tissue; the changes in the muscle only occurring secondarily to this.

In essentials the disease consists of a gradually progressing ossification; which takes place by a hyperplasia of and replacement of the interstitial connective tissue by a loose embryonic structure which recedes and organises to form a cartilaginous ground-substance. In this process the muscle-fibres become atrophied, compressed, and disappear. This cartilaginous ground-substance becomes in its turn the seat of true bone formation. The derivation of the osteoblasts which take part in this process is still uncertain./

uncertain: there is much to suggest that they are probably some of the connective-tissue cells which can assume this special function.

The process may not proceed so far - instead of the formation of cartilage and subsequently of bone, the new loose connective tissue may be the seat of deposits of Calcium salts - lacking the more orderly arrangement found in bone-formation; this appears to be the case in Calcinosis Interstitialis Progressiva. These Calcium salts, plus the atrophied and, it may be, disintegrated elements of the original tissues of the part, provide the detritus found in the lesions of these cases.

Both these two closely allied conditions are due to a primary disturbance of development - in which the mesenchyma, the potential function of osteogenesis, has been impressed on all the connective tissue structures - plus a disorder, the nature of which is quite unknown, of Calcium metabolism; permitting in the one case of the development of hard bony masses; and in the other Calcium deposits in similar situations.

Treatment so far seems unavailing; only too often the little patient becomes "une véritable statue avec la notion d'equilibre" and we are reminded in this disease/

disease very forcibly of the words of that great physician of children - West - who wrote: "We are able to see with more acute perception, the end even from the beginning - to know the thick darkness which will follow what to less instructed eyes may seem but a passing cloud".

X. MYOSITIS OSSIFICANS PROGRESSIVA.

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